Golay–Viterbi Decoding: Results of the MVM'73 X-Band Telemetry Experiment

L. D. Baumert and R. J. McEliece
Communications Systems Research Section

The X-band convolutionally coded telemetry data from the Mariner 10 X-band telemetry experiment have been used to evaluate the performance of the Golay–Viterbi concatenated coding system proposed for Mariner Jupiter/Saturn 1977 (MJS'77).

On January 15, 1974, nearly 70 minutes of simulated X-band convolutionally coded telemetry was recorded at the Goldstone 64-m antenna station. One object of this experiment was the quantitative evaluation of the $K = 7$, rate ½ convolutionally coded, Viterbily decoded telemetry system which is scheduled for use on all Mariner-class spacecraft after 1976. The relevant experimental parameters were:

Data rate:	2.9 kb/s
Nominal E_b/N_0:	3.0 dB
Data sequence:	···10101010···
Code sequence:	···11010111010111010···
Subcarrier frequency:	177.1 kHz
Symbol Synchronizer Assembly (SSA) matched filter quantization:	Sign plus 5 bits magnitude

The bit error probability was calculated over intervals of 1-min duration; the results are shown in the upper curve of Fig. 1. Notice that the bit error probability exceeded the nominal threshold of 5×10^{-3} during the latter half of the experiment. For further details of this part of the experiment, consult the memo by Springett and Kollar (Ref. 1).

After the telemetry was Viterbily decoded, an *error* tape, containing about 10^7 bits, 1 denoting an error, 0 no error, was produced. This tape was then "decoded" by a Golay decoder identical to that proposed for use in the MJS'77 concatenated coding scheme for nonvideo telemetry (Ref. 2). That is, the Viterbi error sequence was assumed to be a sequence of noisy 24-fold interleaved 24-bit Golay codewords, and each such codeword was decoded according to the decoding algorithm $B1$ of Ref. 2. Again the bit error probability was calculated over 1-min intervals; the results are shown in the lower curve of Fig. 1. Notice that the Golay decoder made no bit errors until the Viterbi bit error P_v probability exceeded the 5×10^{-3} threshold. However, during the periods when $P_v > 5 \times 10^{-3}$, the Golay performance also exceeded its threshold 5×10^{-5}.

References

1. Springett, J. C., and Kollar, F. J., "Results of the MVM'73 X-Band Telemetry Experiment," private communication, May 1974.

2. Baumert, L. D., and McEliece, R. J., "A Golay–Viterbi Concatenated Coding Scheme for MJS'77," in *The Deep Space Network*, Technical Report 32-1526, Vol. XVIII, pp. 76–84, Jet Propulsion Laboratory, Pasadena, Calif., Dec. 15, 1973.

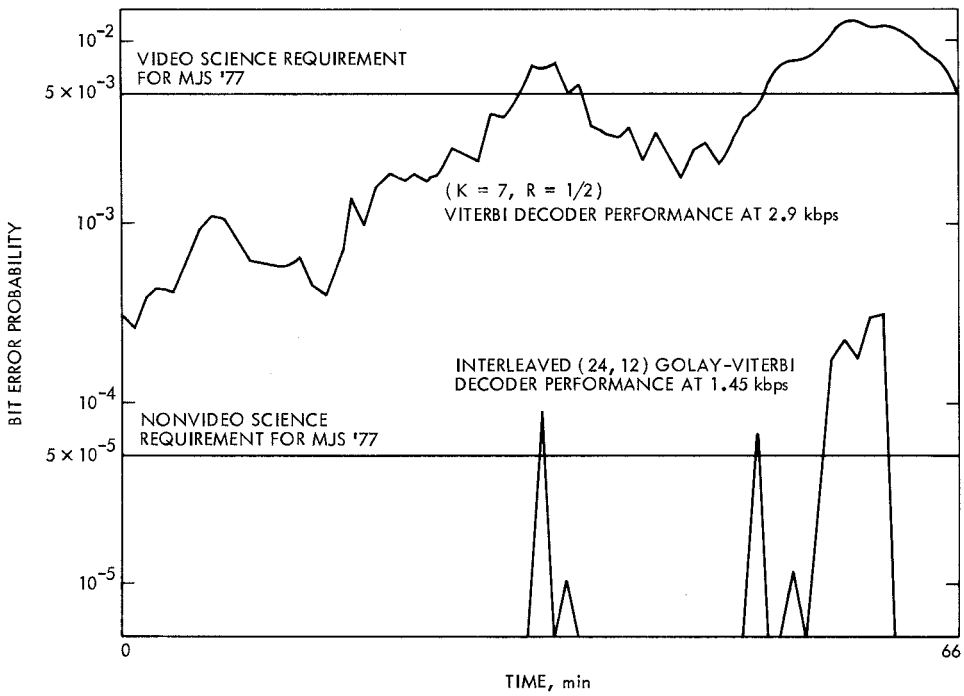

Fig. 1. X-band telemetry experiment coded data results